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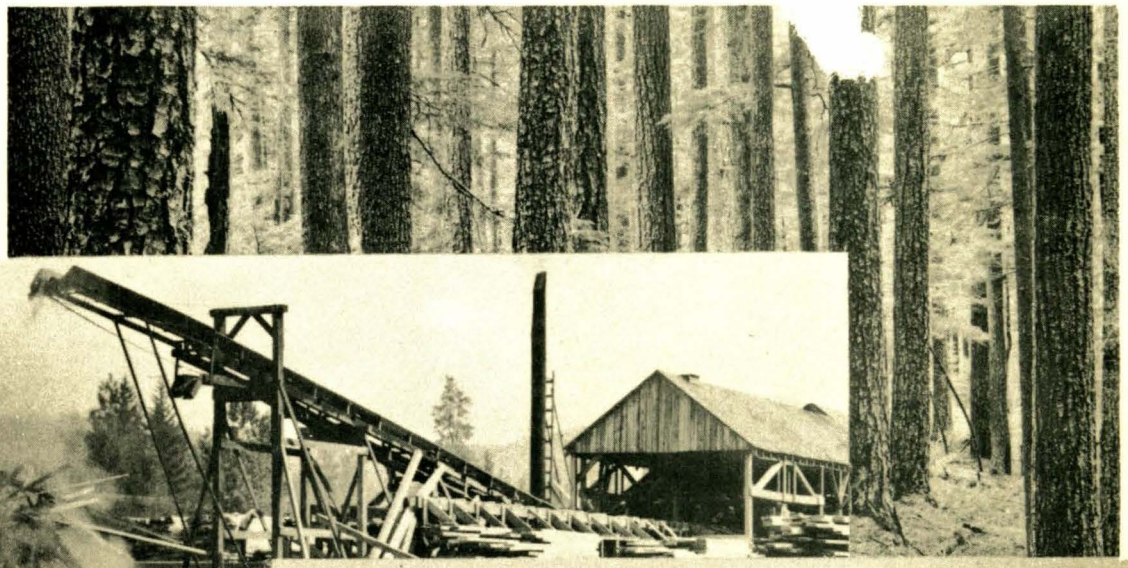
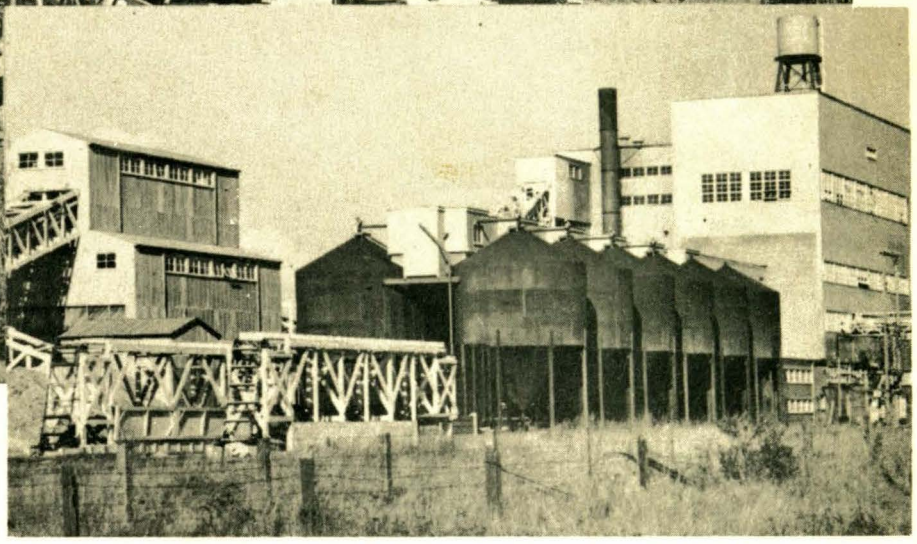
OLD GROWTH DOUGLAS-FIR FOREST : INDUSTRIAL RAW MATL



SAWMILLS WASTE MUCH USABLE WOOD



SPRINGFIELD ALCOHOL PLANT OPERATES ON WASTE WOOD

U.S. DEPARTMENT of AGRICULTURE • FOREST SERVICE
PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
J. A. HALL, DIRECTOR
PORTLAND, OREGON MAY 1947

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ANNUAL REPORT OF THE
PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
FOR THE CALENDAR YEAR 1946

INTRODUCTION

Interest in the future of forestry in the Pacific Northwest probably reached a record high in 1946. Unprecedented demand for lumber, record prices following the lifting of wartime ceilings, and the general readjustment toward peacetime economy, combined to stimulate thought concerning the future of timber supply and the patterns of industry. The Reappraisals conducted by the Forest Service and the American Forestry Association contributed much material and numerous controversial issues for public discussion.

A few major trends are clear.

(1) The exhaustion of easily available old-growth Douglas-fir continues to force migration of the logging and milling industry toward southern Oregon. Old northern and Columbia River mills are closing or facing closure. These are, for the greater part, large mills. Many new mills being built further south are smaller, more modern, and usually more efficient in turning out boards and dimension. It is probable that new installed capacity equals that lost by closure, but new mills do not equal the old in finishing and dry kiln capacity. Thus, manufacturing standards have been lowered.

(2) The new developments in the upper Willamette and southwestern Oregon have now brought Lane County to about 25 percent above its allowable cut and Douglas County to allowable cut and probably above it. New capacity continues to be installed in both counties. It is important to recognize that the heavy overcutting in the Columbia Basin and Puget Sound parts of the region can no longer be balanced against undercutting in the Willamette, Umpqua, and Rogue Basins.

(3) Exhaustion of private timber holdings has brought opportunity to open national forest reserves to cutting, and working circles are moving toward allowable cut levels as rapidly as road construction permits. Sales are heavy and increasing.

(4) Establishment of the first National Forest Cooperative Sustained Yield Unit with the Simpson Logging Company was announced. Other units are in the planning stage.

(5) The trend in utilization is mixed, but generally toward much more intensive use of the crop. The largest factor in the Northwest lumber industry has a rather completely integrated utilization program at one operation which may eventually force removal of all cuttings to about a 4-inch top. Another large organization has a somewhat similar layout nearly fully developed. Several others are in the planning stage.

Relogging of recent cuttings has become extensive and seems to be profitable where sufficiently diversified utilization facilities are available.

Wasteful cutting of old growth continues but it is no longer universal.

(6) Premature and destructive harvesting of second growth is widespread. Encouraged by good pole markets and the rising demand for pulp wood, as well as by the extraordinary prices of common and green lumber, many thrifty, young stands have been liquidated, especially by small owners. Large owners are paying fancy prices for cutovers and young stands to block holdings. They are in sharp competition with smaller operators seeking stumpage.

(7) Lodgepole pine has suddenly become a commercial species of some importance. Also, the formerly despised "upper slope" type, comprising true firs to a large extent, is now moving into pulp production and other fields of utilization. There are no longer "weed species" in the Northwest.

All these rapidly moving developments have posed tasks for research far beyond the capacity of the present staff to accomplish. It is fortunate, indeed, that increased funds available in the middle of the year permitted greatly expanding Forest Management, Range, and Survey staffs so as to be at least more nearly equal to newly imposed burdens. It is also fortunate that the records and experience of some 35 years of previous research are available with which to answer some of the many questions asked of the Experiment Station.

Considering the major trends enumerated, each poses problems to Research.

(1) The rapid migration of industry toward the south brings forceful recognition of the fact that only a few years will see the exploitation of all the hitherto inaccessible south Oregon country. This rugged region has scarcely been touched by research and little is known of management methods required. It is not the same country as the older Douglas-fir region; it differs climatically and ecologically. As an example of radical variation, one highly skilled operator reports that he has obtained evident success by a light selection cut in Douglas-fir, similar to cutting practice in ponderosa pine. Experience with such cutting further north has been distinctly unsatisfactory, but timber in the south is shorter and stands are more

open. Brush problems are different. There is no way to find out how to manage these stands except by accelerated research that tries to keep ahead of the rapidly moving first harvest. Mortality from bark beetles is reaching alarming proportions and there is pressing need for silvicultural methods of beetle control.

(2) In those newly opened parts of the region where allowable cuts have been already exceeded, every effort must be made to bring about the closest possible utilization of the material cut. Relogging operations are recovering up to 30,000 feet per acre of material formerly lost. If this trend can be continued, allowable cut figures can be adjusted upward without increasing the actual rate of timber depletion. However, premature harvesting of second growth must be stopped; otherwise a disastrous readjustment of allowable cut downward will ensue.

(3) The rapid opening of national forest working circles to cutting offers the first opportunities for commercial cutting on some experimental forests. These sales will offer excellent material for the functioning of research in Applied Forest Management, full-scale trial of results obtained on a small plot scale.

(4) As Cooperative Sustained Yield Units are established, it is expected that excellent opportunities will also be afforded for similar cooperative research on the private lands involved. At the same time the results of research are more urgently needed than ever before to guide expanding sustained yield management programs.

(5) Experience has already shown that the Forest Utilization Service is partially satisfying a very real need for technical guidance in utilization. It is not possible to estimate how much the actual contribution of this unit toward the already greatly improved utilization has been or will be. Suffice it to say that the staff has been extremely busy, that their services are in constant demand, and that utilization practices in this region are most certainly improving rapidly.

(6) Destructive cutting of second growth is a serious threat to industrial stability because the practice is destroying a most important part of the resource depended upon to tide over the critical period of old-growth exhaustion that is fast approaching. Growth figures obtained this year on average site, second-growth Douglas-fir showed over 18,000 feet of net increment per acre in the 15 years from age 45 to age 60. This is about the age at which most second growth is being cut. Thus over 1,200 feet per acre per year of growth capacity is being sacrificed by such cutting.

Perhaps of as much importance is the fact that such young trees yield nothing higher than ties or common lumber. The imperative need for intensive work in pruning and thinning of second growth is quite apparent. It is already too late to do much about clear wood

supply for some plywood mills within the next 10 years. Maybe something can be done in the next 30 years, and it is certain that positive measures must be taken if the plywood industry is to endure in anything like its present form. Future clear wood must come from second growth. It is already very late to start work toward growing such material, but it must be grown.

At least a third of the gross growth in Douglas-fir is lost by mortality over a 100-year rotation. Means can and must be found to permit thinning young stands to permit salvage of this volume, and, at the same time, improve growth and quality of crop stands.

(7) Lodgepole pine is being cut extensively for poles, box shook, and even for lumber. Knowledge of management methods is practically nil.

Progress toward bringing deforested lands into production is so slow as to be almost imperceptible. Variously estimated at from three to four million acres in area, these lands are causing the loss of a heavy share of potential production, a loss that cannot be afforded. If they were stocked, doubtless an added increment of a billion and a half feet of timber annually could be obtained. Industry is planting probably 10,000 acres annually, but Survey figures show that, over-all, reforestation since 1933 has just about kept pace with deforestation and, at the present rate, about 200 or 300 years will be required to get back the losses of past years.

This planting task, plus that posed by a large acreage of understocked land, emphasizes the significance of the small work being carried on in the field of genetics and selection of superior strains of Douglas-fir.

In the pine region, a principal problem is that of understocking. There, a great deal of interplanting and reclamation of lost pine sites will need to be accomplished if the yield of pine timber is to be maintained or increased.

It is gratifying that research in pine is again under way after a lapse of several years due to lack of financing. In the elapsed years the increased value of lodgepole and other formerly despised species of the east side has served to provide a clearer orientation of the problems. It appears that a considerable diversification may be possible in eastern Oregon and Washington, and that the formerly difficult task of maintaining more or less pure ponderosa stands may be somewhat eased in the direction of mixed stands, easier to handle, but requiring diversified utilization beyond anything formerly thought possible.

At the same time the rapid development of irrigation and power on streams of the east side has served to emphasize the significance of

forest and range management policies. Water is rapidly assuming the same relative importance that it has in other similar semiarid districts and this importance will grow. The east side has over 14,000,000 acres of summer range, an important resource. But it is also very important to recognize that over 13,000,000 acres of this summer range is ponderosa pine land, nearly all available for commercial cutting.

Since most of these lands lie at the headwaters of important streams, the significance of good management of these two great overlapping resources, timber and range, is enlarged to a great degree. At present, about 370,000 acres are being cut over each year. Methods of cutting and proper methods of integrating range use with reforestation and forest management are major objectives of research.

Although the proportion is doubtless higher in limited areas, the over-all demands on summer range by big game amount to 14 percent of the total. This in itself does not appear alarming, but locally, intense competitive situations arise. There is still a lack of basic information on which to base game management practices. As a recreational resource of real financial value to the territory concerned, this big game resource can hardly be overestimated. But ways must be found to permit the livestock industry, timber management, and big game to exist side by side, while the water resource is unimpaired.

Grazing research at this Station is practically confined to lands east of the Cascades, and is quite inadequate to face all the tasks involved even there. Excellent progress is being made in the reseeding program, in effect a program aimed at reclaiming lost grazing capacity and raising the level of existing capacity. But there are grazing problems of some magnitude west of the Cascades, zones of tension in land use, where guidance is badly needed in the framing of land management policies. Thus far, little more than appraisal of the problems involved can be accomplished.

These problems and a host of others emphasize the most glaring blank in the program of this Station--Economics. Work in Economics is confined to the Forest Survey, which has just this year been so financed as to permit keeping the inventory up to date. The values obtained from the Survey in guiding industrial development are of inestimable value. But, except for a small amount of cooperative work financed by the Bonneville Power Administration, badly needed research in Economics is being left undone.

New industries based on wood are being established rapidly in this region and many more are in the investigative stage. The investigations are largely economic in their nature and those who would establish new outlets for wood now wasted need expert counsel from a trained staff, skilled in both forest economics and forest products economics.

It is a startling fact that 57 percent of the privately owned timberland in this region is in ownerships of less than 5,000 acres. No form of stable business organization is present within which sustained yield forestry is functioning over this vast area of nearly ten and a half million acres of productive timberland. It is this block that presents the greatest economic problems in forest management and orderly utilization that are not now being touched by research.

The second important gap in the existing program is in the field of Forest and Range Influences, the flood and water supply problems growing out of watershed management. It is perhaps significant that there is growing opinion that this country is experiencing worse floods from less rainfall than in the past. Likewise, more attention than ever is being given to matters of irrigation and municipal water supply. But most discussion about these things must lie in the realm of opinion because no data of any consequence are available in this region that demonstrate the relations existing between forest cutting practices, fire, slash disposal, grazing, and streamflow. Until work is done in this field, upstream and downstream activities will continue to be unguided by sure knowledge.

FOREST ECONOMICS

Forest Survey

Conclusion of wartime obligations and increased legislative appropriations for F.Y. 1947 resulted in a complete reorientation of Forest Survey methods and programs during the calendar year 1946. At a Survey conference in Washington, November 1945, objectives and policies were formulated and in May 1946 a two-weeks meeting was held at Petersham, Massachusetts, to discuss and develop Survey techniques for forest inventory. Cowlin attended the Washington conference and Cowlin, Moravets, and R. C. Wilson the Petersham conference.

During the first half of 1946 progress of the field program was retarded by detail of Cowlin to the Reappraisal Project in Washington from January to June, attendance at the Techniques Conference, and transfer of Meagher in April to the Southwestern Station. Despite these interruptions, the field reinventory of Multnomah and Klamath Counties was completed. Office compilation of timber volumes for Clackamas County and type areas for Multnomah County were completed.

"Forest Statistics for Clackamas County, Oregon" and "Forest Statistics for Marion County, Oregon" were prepared and released. Clackamas County had a total of 16.1 billion board feet of saw timber in 1944, of which 13.1 billion feet was national forest and 2.3 billion feet was private. At the time of the original inventory in 1933 the county total was 18.9 billion feet, of which 13.3 billion feet was national forest and 4.9 billion feet was private. The net decrease of 2.8 billion feet in saw-timber inventory during the 12-year period took

place almost entirely in private timber which was reduced more than 50 percent, a reflection of the demands of the Portland industrial area. Allowable annual cut for the county was estimated at 350 million board feet and current annual drain at 332 million feet. The situation is not as favorable as this comparison indicates as cutting has been concentrated on the better forest lands and allowable cut calculations were based on more intensive management and utilization of second growth than now prevails.

The Marion County report shows that total saw-timber volume decreased from 8.3 billion feet in 1933 to 6.8 billion in 1944, a drop of 18 percent. National forest timber totaled 4.8 billion feet in 1944 compared to 4.9 in 1933; in contrast private timber was 1.3 billion feet in 1944 and 2.9 billion in 1933. Total allowable annual cut for the county was calculated as 112 million feet in 1944 and current annual drain at 158 million feet.

An increase in the Forest Survey allotment to $65,000 for F.Y. 1947 permitted the acceleration of inventory maintenance and expansion of other phases of the Survey. A ten-year program was formulated which schedules a progressive field reinventory of the region once each decade. Approximately 5 million acres of forest land will be covered each year and at the end of the decade the region's total, 49.8 million acres, will have been completed.

A working plan was prepared and submitted to Washington which was designed to fulfill the objectives and policies adopted at the Washington Survey conference. This plan embodies methods that depart significantly from those formerly used. Aerial photos, wherever available, will be used as a basis for type mapping and determination of forest land area by forest type. Intensive ground reconnaissance will supplement photo interpretation and more detailed and accurate type maps will result from this combination of methods than was possible under previous methods. These maps will continue to be published in county units on an inch-to-the-mile scale.

After careful investigation of methods of instituting accuracy control of estimating timber volumes obtained through the compilation system it was decided to determine timber volume hereafter by random sampling. Chapman and Osborne of the Washington Office and members of the Station staff spent several weeks studying this subject and the plan finally developed for determining accuracy of results obtained by the compilation method was judged too costly.

The new system of timber volume estimation, which is incorporated in the working plan, is designed to give total saw-timber volume in terms of 15-million acre units within the sampling error of $\pm$ 2.5 percent (one standard deviation), set as the national survey standard.

The working plan also includes provision for obtaining gross growth and mortality data in mature forests concurrently with inventory

volume data. This feature is another departure from the original methods of estimating growth, which assumed that mature forests in the Douglas-fir subregion were, on the whole, in a static condition with growth offset by mortality and other endemic losses.

The working plan prepared by Moravets, with R. C. Wilson contributing the photo interpretation sections, is being tested in the field in Jackson County, Oregon.

A test of classification of commercial forest land was made by dot sampling of aerial photographs in Jackson County. Statistical analysis showed that the sampling system developed will provide estimates, at a comparatively small cost, of commercial forest land area within the national survey standard of accuracy ($\pm$ 1½ percent for 15 million acre units, one standard error). The aerial photo sampling showed that 73.3 percent of Jackson County is commercial forest land, compared to 73.7 percent obtained in the original survey by ground methods. If tests to be made in other counties show similar close comparisons it may be concluded that the original classification met the accuracy objective recently established.

A conference was held in early December to consider methods of determining cutting drain. The meeting held in Portland was attended by Crafts and Osborne of the Washington Office and representatives of the Northern Rocky Mountain, California, and Pacific Northwest Stations. It was decided to request Budget Bureau approval of forms for obtaining production of logs and other timber products from primary producers and in some cases consumer by mail and field canvass. Forms were prepared and working plans made for submission to the Budget Bureau. This procedure, which will give more complete and reliable data on cutting drain than has been possible in the past, will be initiated in 1947 if approved. Estimated sawlog production in this region for 1945 was 9.3 billion board feet, log scale, composed of 7.9 billion board feet in the Douglas-fir subregion and 1.3 billion board feet in the pine region. Volume of cutting of products other than logs and utilizable logging waste must be added to these figures to determine total cutting drain upon the growing stock. No reliable figures are available for these drain factors. The new plans include provision for obtaining such data.

Major lines of activity in 1947 will be prosecution in the field of the inventory, drain, and growth phases of the survey, development of working plans for office compilation and analysis of inventory and growth field data, completion of a comprehensive field manual now under preparation, research in aerial photogrammetry and preparation of analytical reports. Plans are being made for a comprehensive analysis of the forest situation in the Willamette River unit.

Columbia River Basin Study (Bonneville Cooperative Project)

Working under a two-year cooperative agreement with Bonneville Power Administration the Station is making a study to determine, within a

reasonable range, the probable levels of production and employment in the forest industries of the Columbia River Basin for the period 1955-65. Log production and log movement have been forecast from an analysis of timberland ownership, allowable cut, and the probable management plans on forest lands in different classes of ownership. Log consumption, based on production, has been allocated by primary products for the forecast period. Secondary manufacture has been estimated on the basis of plant facilities, plans for expansion, and economic opportunities. Estimates have been made for individual study units corresponding roughly to our Survey units.

A statistical summary was forwarded to Bonneville Power Administration in December. The textual material is due March 31, 1947, and the project will be closed June 30.

From this report and reports covering other industries, Bonneville Power Administration will estimate total unit and basin power requirements for the forecast period. These will be forwarded to the Corps of Engineers, to make up part of the Engineers' report to the Congress on the need for power dam developments. Under the terms of the working agreement we are not permitted to disclose or publish any results of our study until this final report has been made by the Corps of Engineers.

Fire Economics

Work on this project was terminated with the transfer of Matthews to Region 1 in July, with the exception of review and editing of the final report.

The analyses of fire damage were completed for the seven sample areas--Snohomish, Yakima, Clark-Skamania, Linn, Douglas, Coos-Curry, and Southwest Oregon. Reports were prepared for use of the local Clarke-McNary administrators in revising cost of adequate protection estimates. This material was combined with statements of the purpose, basic idea, methods of study, and a discussion of the application of results in a complete report which was sent to the Regional Office and State Foresters for review and comment.

Requirements, Products, and Supplies

Monthly reports on factors affecting lumber production continued throughout the year to show manpower the most important adverse factor. However, by the close of the year the manpower situation improved and equipment deficiencies became a more important factor. For the year, as a whole, equipment was the next most important factor adversely affecting production. The difference in importance between the manpower and equipment factors was much narrower during 1946 than during 1945. Weather was the third most important factor, followed by timber shortage. The latter is sharply increasing as an adverse factor. It is estimated that 1946 lumber production is 5 percent greater than 1945 in the fir region, and 16 percent in the pine region.

Estimates of gross lumber stocks at mills of the Douglas-fir region were prepared monthly through 1946. Stocks as of November 30 were 510 million feet, an increase of 142 million feet from those of November 30, 1945. The trend was downward during the first part of the year, reaching a low of 312 million feet as of April 30. Since that date, stocks have increased quite rapidly, partly as a result of maritime tie-ups and railroad car shortages.

Monthly reports in the three major log markets--Puget Sound, Columbia River, and Grays Harbor--showed a strengthening in log reserves. As of December 1, 1946, log inventories of the three markets combined were 12.7 percent greater than those of December 1, 1945, but were still below 1939-42 average by 15.3 percent. Log inventories for the entire fir region were made quarterly. The December 1, 1946, total inventory was 21 percent greater than that of a year previous.

A special report of the situation in the softwood plywood industry and its future outlook was prepared in collaboration with the Regional Office. In connection with this report, S. A. Wilson made a short trip to Washington. The report showed that nine plants, representing about one-fourth of the current installed capacity, had less than 10 years' life expectancy based upon visible raw material supplies and another seven plants, with about equal aggregated capacity, had from 10 to 20 years' operation in prospect.

Other special reports prepared by Wilson estimated number of gyppo loggers and their employees, employment in logging and sawmill establishments, employment in plywood plants, and discussed quantity and character of sawmill waste.

Cooperative Lumber Census

The annual lumber, lath, and shingle census was conducted for 1945. Owing to delay in execution of the cooperative agreement and receipt of the schedules it was not completed until late fall. The total 1945 lumber production of Oregon and Washington was 8.3 billion board feet; of this total, Oregon produced 5.0 billion feet and Washington 3.3 billion. Oregon had 744 active mills, Washington 504, or a total of 1,248.

Financial Aspects

Continued demand for data on lumber grade recoveries by log size and grade, milling costs, and log values by size and grade has led to resumption of mill-scale studies in the Douglas-fir region. It was decided to initiate a series of studies in four or five mills which would reflect recoveries from distinct forest types and for which lumber grade recovery data are not available from previous studies. These types are the Coast Range old growth, southern Cascade old growth, southern Oregon mixed stand old growth, and coastal type bastard fir. Cooperative help was offered by the West Coast

Lumbermen's Association, the Regional Office, and O. & C. Revested Lands Administration. Field work is finished, compilation is under way on the first of these studies at the mill of the Austa Lumber Company, and will be completed about February 15, 1947.

In addition to these studies, which will be integrated with a program of the Western Oregon Work Center, it is also planned to obtain data on production costs and sales realization of the various products logged from second-growth stands. The latter project will be initiated at the Western Washington Work Center and will commence with a lumber grade recovery study of a small mill cutting second-growth Douglas-fir. This study, which will commence about February 1, will also be a cooperative project, with the West Coast Lumbermen's Association furnishing the services of a lumber grader and the Division of State and Private Forestry, Regional Office, contributing services of a farm forester. It will be followed by a logging cost study by tree sizes. Both these projects are being supervised by Matson of Forest Management.

FOREST UTILIZATION SERVICE UNIT

The staff of this unit for the major part of the year was comprised of J. J. Byrne, E. G. Locke, and E. E. Matson. In October, A. C. Knauss arrived and Matson was transferred to the Division of Forest Management Research.

The highlights of accomplishment in the utilization field in the Pacific Northwest during the past year have been:

1. The tremendous increase in the salvage logging of cut-over lands.

2. The completion of the Springfield alcohol plant.

3. The successful operation of the Bellingham alcohol plant where sulfite waste liquor is the raw material.

4. Investigations of possibilities of establishing an industry utilizing offal from the lumbering and pulp industry for yeast for feeding livestock and poultry.

5. The successful operation of a small board plant and the construction of a large plant to operate on Douglas-fir mill and wood waste.

6. The construction now in progress of additional sulfate and soda pulping capacity to utilize Douglas-fir mill and wood waste.

In general, the attitude of industry toward close utilization of forest material has been greatly improved. This is evidenced by the

widespread adoption of measurement of logs by cubic volume and weight rather than by the Scribner board scale which implies considerable wastage of the log in lumber manufacture. Now the log is beginning to be considered on the basis that all of its volume has potential usefulness.

It would be difficult to gauge the contribution of the Forest Utilization Service in this great advance in utilization practice. However, it has contributed. Its help is being sought more and more as industry becomes acquainted with what it has to offer.

The increase in salvage logging or "relogging" as it is called in this region has been accelerated by favorable economic conditions. The Forest Utilization Service unit has kept in touch with advances in this field and has acted to advise operators in improved methods and equipment. It has also encouraged and promoted more widespread adoption of the practice. Some operators are recovering on the order of 20,000 board feet of logs per acre--material which in the original logging had been left as being not economically feasible to recover. In some instances "relogging" is carried to an extent where burning of slash is obviated. At the same time, soil is exposed in the operation. Both of these factors contribute toward the early establishment of a new tree crop. Matson and Byrne have collected information on amounts of salvage (from State and Private Forestry, R-6), on equipment used, and on costs of "relogging." This material will be combined with other information collected by Oregon Forest Products Laboratory and an article will be published with a view toward encouraging more "relogging."

The alcohol plant at Springfield, Oregon, where wood waste will be converted into industrial alcohol, has been completed and a crew is on hand testing equipment and "feeling out" the process. At first, only one percolation unit will be operated for the purpose of training operating personnel and testing the process. Gradually, the other four percolating units will be brought into operation. The completion of this plant has been delayed by shortages of electrical equipment and, even yet, some improvisions have been made which will be eliminated as soon as equipment is available.

During the long course of construction, Locke acted in liaison between the Forest Products Laboratory, the Vulcan Copper and Supply Company, and the Willamette Valley Wood Chemical Company. He has given advice and other assistance on the program for construction and operation of the plant. He also has kept the Laboratory informed as to problems which have arisen and has worked on special projects with the Laboratory on byproduct development.

The alcohol plant at Bellingham, Washington, operated by the Puget Sound Pulp and Timber Company, has been purchased by that company. It has been in successful operation during the year, producing from six to eight thousand gallons per day of industrial alcohol, quite well above estimated original capacity.

A shortage of protein for feeding livestock and poultry is prevalent throughout the West. A high-protein feed yeast may be produced from the spent beer of an alcohol plant such as that built at Springfield, from the sugar produced from the hydrolysis of wood waste, or from waste sulfite liquors. One phase of the Washington Pulp Mill Research program currently under way at the University of Washington is the operation of a laboratory-sized pilot plant producing yeast from waste sulfite liquor. Locke has served as a consultant in this program. In this region there is need for the development of a yeast industry based, not only on waste sulfite liquor, but also on the other raw materials listed. The logical place for a semi-works plant, to test out processes already carried through the laboratory stage at the Forest Products Laboratory, is at Springfield where the equipment of the alcohol plant can be used to produce both whole wood sugar and spent beer for feed to the yeast plant. With this in view, Locke has worked out estimates for a demonstration plant and the establishment of such a plant at Springfield is being proposed.

The market for high-protein concentrates has been explored and was found to be approximately 100,000 tons per year in Oregon and Washington for the turkey and chicken industry alone. Feeding tests have been proposed to the State Colleges of Oregon and Washington.

The problem of utilization of old-growth Douglas-fir for pulp is one of the major problems in the region. The large volumes of sawmill and logging waste from old stands exceed the potential market for material of this nature. Furthermore, old-growth Douglas-fir is inferior to young growth for pulping by present processes. Even in insulating-board manufacture, young growth is preferred. There is need, therefore, not only for the establishment of new mills to use Douglas-fir but also to work out better pulping methods. Industry is aware of the scarcity of mills suitable for Douglas-fir and some companies are expanding their facilities and probably will continue to do so in the future. Crown Willamette is doubling its capacity for utilizing Douglas-fir. Weyerhaeuser, also, is building a new sulfate plant. Work leading to better utilization of old-growth Douglas-fir for pulp and fiberboard has been instigated.

The Chapman Company of Corvallis has constructed a low-cost plant for producing hardboard from Douglas-fir slabs by a new process and has been in successful operation during the year. This type of plant opens up a new field for waste utilization on account of the low capital investment required.

The Simpson Logging Company has completed a new board mill which will utilize waste from its sawmill as well as woods waste as raw material.

In this region there are large volumes of defective trees which in some stands are said to amount to about 75 percent of the standing timber. Some of these trees contain enough sound timber to warrant

the development of means of salvaging it. One operator has developed a portable mill to handle logs about 8 feet in length and 5 feet in diameter and is experimenting in recovery methods. This problem is being studied with a view toward working out not only the most practical method for recovery of sound lumber, but also the best methods for utilizing the remainder by chemical processing methods.

The recovery of timber from the Tillamook burn is proceeding at a slow pace. The State of Oregon has assumed the major responsibility for the rehabilitation of this area and as yet has not taken any extensive action. Advice has been given to some operators as to the availability of portable sawmills suitable for recovering this material in cant form and shipping it to mills for remanufacture. It appears that, at the present time, the recovery of sawlog and peeler material is the most practical form of recovery. The use of this material for pulp is precluded by the charred nature of the material. It is excellent raw material for charcoal manufacture but as yet the cost of collection has been too great.

The development of cut-stock industry in this region is in progress. This is similar to the dimension stock industry of the hardwood areas. At present one operator has over 20 small plants set up to salvage waste slabs and edgings from the waste conveyor at sawmills. The salvaged material is squared up and shipped to a central plant for drying and processing. This central plant handles over 100,000 board feet per day, converting it into handles, furniture and toy parts, venetian blind parts, glued cores, and numerous other small articles. This unit has collected data for a publication designed to encourage this practice in this and other regions.

It is felt that the establishment of the newly formed Pacific Lumber Remanufacturers Association will be a good influence on wood utilization in this region. This organization foresees the establishment of concentration yards where the production of small sawmills may be collected, seasoned, and remanufactured into a high-quality product which will bear shipping charges. Cut stock from waste and from No. 3 and worse lumber will be fostered. The organization will act as an intermediary between buyer and supplier. It will have a staff to explore market and advise operators. Matson spoke before a recent convention of the members of this association and pictured for them the possibilities in the use of salvageable sawmill and logging waste. Arrangements have been made to have an expert from the Laboratory participate in a clinic on small sawmills for Oregon operators with a view toward assisting them to get more efficient and high-quality production.

The shortage of lumber for crates and boxes in the agricultural areas of Washington and Oregon has caused the box manufacturers to explore sources other than pine for box construction. White fir, Douglas-fir, larch, and other species are now in current use, particularly for tops and bottoms. Fairly large amounts of tops and bottoms

are being shipped from the west to the east side. Most of these are constructed from veneer either peeled or sliced. A new high-speed slicer has been developed and there is promise of an accelerated production of box parts by this method in the future. This unit has encouraged the production of box parts from salvageable material from logging waste.

The Forest Utilization Service at the California Station shipped certain western hardwoods to the Laboratory for test. These included tanoak, of which there is a fair volume in this region. Also, Oregon Forest Products Laboratory has done some seasoning work on tanoak at Corvallis. It appears that this oak makes an excellent veneer and is a potential source of material for flooring and furniture. This use has been examined and prospective operators informed of the status of work to date.

The successful operation of the Western Pine Association's pilot plant at Bend, Oregon, on solvent seasoning of ponderosa pine has suggested the possibility of applying this process to the seasoning of local hardwoods which have proven difficult to season in the past. Work along these lines has been discussed with local agencies and with the Forest Products Laboratory.

In view of the shortage of building materials, particularly for flooring, the Laboratory has been encouraged to examine the possibilities of partially compressed resin-impregnated facings for Douglas-fir plywood. This work shows promise and will be continued. The Douglas Fir Plywood Association is greatly interested in this development as well as the possibility of using veneer from western hardwoods for floor coverings.

One of the problems of the Douglas-fir plywood industry is the prevalence of checks in exposed Douglas-fir plywood. Various means have been proposed to overcome this handicap, such as facings with impregnated paper and special working of the surface. Knauss is keeping in touch with developments in this field and is keeping the Laboratory informed.

The glue industry is in a constant state of accelerated evolution in the development of new glues. Work during the war at the Laboratory on the durability of glues indicated that not enough attention had been given to this feature in such long-time construction as that of houses where moisture and heat were present in some areas. Knauss has advised local fabricators on the findings of the Laboratory and his services are in demand in the field.

Although seasoning practice in the Pacific Northwest is in advance of most areas, it is still inadequate in extent of application. Too much green lumber is being shipped and used for construction. There is need for promotion of concentration yards and other tools conducive to getting a properly dried product. Hardwood seasoning, in

particular, has been sadly neglected in this area from the standpoint of the application of developed techniques. This phase of timber processing has been studied during the past year and general plans laid for future action.

One of the developments in good utilization in the pole industry is the practice of one company to buy tree lengths, peel, cut tops to post lengths, and use the slabs from the sawmill to construct playhouses for children. Other operators have been encouraged to follow the practice of using the full length of the tree. A limitation is the restriction on length of load allowed on State and county highways.

This unit made arrangements for the procurement of second-growth Douglas-fir for a major study to be conducted by the Laboratory on its properties with relation to conditions of growth. Matson assisted Koehler and Paul of the Laboratory in selecting the particular trees to be logged. Matson also supervised the shipment of the logs to the Laboratory. The study contemplates treating second-growth trees as a completely new species and running tests of structure, chemical composition, strength, density, drying characteristics, veneer slicing, pulping, machinability, and many other tests. The properties will be correlated with conditions of growth.

Locke has acted as an intermediary between Bonneville Power Administration and Oregon Forest Products Laboratory in setting up a cooperative project on charcoal research. Briquettes, specially prepared in the pilot plant at Oregon Forest Products Laboratory, were tested by the Electro-development Laboratory of the Bureau of Mines at Albany, Oregon, as reducing carbon in electric furnaces. Also, these briquettes were tested by the Bonneville Power Administration for use as a domestic fuel. The results were excellent in both cases.

Members of the unit staff accompanied the following visitors from the Laboratory as indicated below:

1. J. S. Matthewson on a review of plants seasoning hardwood in this region.

2. Ray Miller and Gene Fobes on a survey of logging equipment and methods.

3. E. M. Davis on a review of different types of sawmills to ascertain what mills are better adapted to cut white fir.

4. T. R. Truax on a review of wood-utilizing industries in this region.

5. G. H. Chidester on a survey of the pulp, paper, and fiberboard industries.

6. J. O. Blew and Wayne Hutchins on a survey of wood-treating plants.

7. R. F. Luxford, O. C. Heyer, T. S. Martin, and F. A. Strenge on a survey of prefabricated housing manufacturers.

8. R. J. Seidl on a survey of fiberboard and pulp and paper mills.

9. Claude Bell (with staff of California and Northern Rocky Mountain FUS units) on a general review of utilization practices in this region.

Locke has continued to act as a technical advisor to the Oregon Forest Products Laboratory and assisted in preparation of its work program.

A number of talks before technical groups and chambers of commerce have been given by the staff. Also, assistance has been given in the preparation or review of papers and publications by other parties.

Members of the staff participated in a training program, a work planning meeting, and a policy meeting at the Laboratory during the year.

Locke accompanied Hall to a meeting at the Northern Regional Laboratory, where the Bureau of Mines, the Bureau of Agricultural and Industrial Chemistry, and the Forest Service discussed progress in research on liquid fuels.

The staff has answered many inquiries and has given consulting services on problems in wood utilization in the region.

It has also played host to the other western Forest Utilization Service units, at which time problems of mutual interest were discussed and the visitors shown the highlights in wood utilization in this region.

It was largely through Locke's efforts that the inertia which gripped the newly formed Northwest Forest Products Technologists Association was overcome, and a highly successful meeting was held in which ground work was laid for activation of this organization, which will probably be the nucleus of a Nation-wide organization of wood technologists.

FOREST MANAGEMENT RESEARCH

Forest Management Research activities for 1946 may be characterized by the one word "rebuilding." Technical staff, numbering a total of 2 on the job at the year's beginning, had grown to 15 at the year's ending. This expansion, although planned in a general way, could

not have been accomplished without devoting major effort to recruitment, program planning, and personnel training.

The year gave us opportunity to follow through on delayed remeasurements of existing plot installations, to appraise their present and ultimate values, take a closer look at pressing forest management problems, and lay research plans promising authoritative answers. Detail of this activity is given in the project sheets. It is unlikely that such a year could have yielded monumental immediate returns in terms of finished forest management research results, and it is certain that it did not. Nevertheless, if we have laid sound foundations for such results in years to come, the effort of 1946 will be proved to have been a prudent investment.

The year just passed did contribute several pieces of usable research results, mostly fragmentary in nature, but filling some of the troublesome blank spaces in the mosaic of forest management know-how and giving clues to further solutions.

Douglas-Fir Silviculture and Regeneration

Over the past decade extensive attempts have been made to effect an orderly transition from mature virgin Douglas-fir forest to rapidly-growing, managed forest by selective cutting. Last year's compilations of results from 72 acres of permanent sample plots on ten typical areas of partial cutting showed that annual net loss had averaged 1,467 board feet per acre during the 5 years since cutting. This does not count the additional loss from decay in the reserved stand that results following logging injury. This year's progress on our studies with Forest Pathology indicates that one-third of the reserved trees may be seriously scarred during selective logging of not more than 30 percent of the stand. Spruce, hemlock, and balsam firs thus injured were found to lose sound wood volume by decay at the rate of 1 percent per year on typical areas, despite little surface evidence of deterioration. Clearly, Douglas-fir selective logging, as practiced to date, largely as a high-grading operation, has failed to accomplish the objective of converting static forests to net growing condition. New approaches are needed. Starting next year we plan to devise and give them systematic test on experimental forests on a commercial scale.

Current reappraisal statistics show that the area of nonstocked and poorly stocked land in the region has not been significantly reduced since the time of the initial forest survey in 1933. If some 3 or 4 million acres in need of planting is to be substantially reduced and restored to productivity within any reasonable period, faster, cheaper, and more effective methods of seeding and planting must be developed. The Station should take the lead in this activity and a lot of project rebuilding will be necessary in order to do so.

During the past summer the Station cooperated on checking results of the first test of the Miller planting tool--the first attempt in this region to mechanize the job of planting forest trees. The tool proved to be faster by 14 percent than the grub hoe in planting, and first-year survival on north slopes was slightly, though not significantly, greater--94 percent in comparison to 93. On south slopes, however, survival of tool-planted trees was significantly poorer--83 versus 94 percent. A series of fertilizers and hormones used in connection with the tool-planted trees failed to improve survival, and in some cases were lethal. The conclusion is that the Miller tool holds some promise but techniques in using it must be worked out and mastered before it can make a substantial contribution to our planting problem.

Recognizing the importance of obtaining the best possible seed for use in reforesting, the Station this year cooperated with the University of Washington on a preliminary study of strains of Douglas-fir. The study uncovered evidence that some are significantly superior. For example, in our own experimental plantations, progeny from one seed source grew 22 percent better than the average; those from another source, growing under the same conditions, made 30 percent poorer than average growth rate. In European plantations testing strains of Douglas-fir from the complete natural range of the species, it was found that the best was making three times the growth of the poorest.

Problems of Douglas-Fir Second Growth

Some of the most critical forestry problems in the region result from the precipitate premature clear cutting of rapidly growing stands of Douglas-fir second growth. The research problem that generates therefrom is to determine or devise specific procedures for management that will result in improving and continuing high levels of volume and value production. Foresters agree that broad-scale applications of thinning should result in improved volume and value growth rate, and in addition yield valuable products and income to the owner. Their recommendations are ineffective without benefit of test and demonstration. Until such operations are proved to be highly practical on a broad scale, little progress in furthering their use in the forests of the region can be expected. Thus, a major research project proposed to start immediately is the working out and demonstrating in detail the best methods of managing the timber crop upon which depends the perpetuation of the region's principal industry.

One of the purported advantages of thinning is that by so doing the natural mortality occurring during the life cycle of a stand may be salvaged or averted and the net yield thus be effectively increased. Analysis of long-time mortality records on our permanent plots, made during the year, show that natural mortality over a rotation period may amount to one-third or more of present live stand volume, and if this loss can be forestalled by thinning and utilization, forest productivity will be correspondingly increased.

Ponderosa Pine Silviculture

The editing, multigraphing, and distribution of "Calculating the Growth of Ponderosa Pine Forests" represents the Station's 1946 contribution in the field of pine silviculture and mensuration. This progress report, which presents new techniques of growth estimating, has already become a handbook of the foresters preparing pine management plans for private, Indian Service, and Forest Service timberlands. It is already in need of expansion and revision, which can only be done on the basis of experience and data collected from carefully controlled plots. There is a large amount of project rebuilding to do to get those basic data.

Within the past year lodgepole pine has passed from the category of a noncommercial to a commercial tree. It forms the principal cover type over 2 million acres in the pine region and represents a large wood fiber supply and population support potential. Its silviculture in this region is practically unexplored.

The year 1947 will mark the start of large-scale planting program in the pine region, also badly in need of guidance by research.

Fire Studies

It is incongruous, indeed, that in this region, which ranks first in timber volume and spends millions on fire protection annually, the allotment for fire studies is a mere $5,000. This is not even enough to handle routine research services, such as fire weather record analyses and consultation on protection planning.

General statements regarding severity of regional fire weather are likely to be inexact and misleading. Our fuel moisture stick analysis this year showed that at many low-elevation fire weather stations west of the Cascades, 1946 produced more severe fuel moisture conditions than any of the previous five years. At high-elevation stations, however, the conditions were more severe in Washington State only. East of the Cascades the conditions were less severe than in other years. The general impression of many fire control men has been that the weather was uniformly very favorable in 1946 in both States as a whole.

Work was begun to determine the effects of different severities of slash burning in the Douglas-fir region upon natural reproduction, occupation of the site by brush, and rate of growth of reproduction. Greater and greater clear-cut areas of the highly inflammable Douglas-fir slash have been left unburned in recent years. Such a policy is sometimes based on previous studies of this Station showing that in certain cases seedling survival on deeply burned surfaces is less than on unburned surfaces, but the Station does not have sufficient information to state the effect of a light burn or the comparative silvicultural effect of any degree of burning versus nonburning under

various combinations of conditions. Fire protection organizations are worried by the accumulating hazard and want to know the best policy to be followed. Twenty-four pairs of plots in which one was burned and one beside it was left unburned were established in different localities from southern Washington to southern Oregon. Additional plots in all parts of the Douglas-fir region will be established in succeeding years. From periodic observations and measurements of growth on the plots, specific information will become available for formulating a sound policy of slash treatment.

A procedure was developed, tested, and described for determining the maximum area of a given slash hazard exposed to given fire-starting risks that can be adequately protected with given protection facilities for 25 cents per acre or any other fixed amount. State forestry laws and policies allow the State Foresters to assume the protection of cut-over land covered with unburned slash upon agreement with the owner. Otherwise, the owner is legally responsible for removing the hazard. The State Foresters, either by law or policy, can collect a fee of 25 cents per acre for six years or a total of $1.50 per acre for protecting the extra hazard of unburned slash. The protection agency is confronted with the problem of deciding which areas can be protected, or the size of a given hazardous area that can be adequately protected for this fee. A large number of cases require this decision annually and the number is increasing each year. The protection agencies want a procedure that will facilitate this work. Our study shows that, for the average protection organization, the area of slash that can be protected for 25 cents per acre per year for six years varies from 1 acre to 2,500 acres, depending on the fuel type or kind of slash, the protection facilities, and the risk of fires being started by various causative agencies. Directions are given for determining the weight of each of these qualifying factors.

One field where the results of fire studies research are being eagerly applied, and where high operation costs afford a chance for large savings through better methods, is in aerial fire control. Our preliminary tests of smoke searching techniques indicate that aerial detection efficiency may be increased severalfold by applying known principles of smoke visibility so as to use the most advantageous timing and charting of flights and "looking" techniques. Dependable rules are far from completely worked out, but here are a few of them: (1) Smokes in sunlight are most visible when looking into the sun. (2) Plan detection flights so that the observer will have the sun at his back as little of the time as possible. (3) If lightning has been reported in a limited area, fly back and forth so that all of the area is ultimately seen while looking toward the sun. This flight pattern should also be used when inspecting an area of extra hazardous fuel or one subject to extra fire-starting agencies. (4) If an observer is uncertain whether an object is a smoke, circle the object and view it toward the sun. (5) On an overcast day the position of the sun has no effect. (6) In rough topography or tall timber smokes can be seen best during midday when the sun is high so that it shines on the smoke,

and flights should be made then. (7) If a flight must be made when the sun is low and shadows are common, or if a smoke is suspected to be in a spot where there is a shadow, fly with the sun at the observer's back.

Mensuration

One of the most glaring gaps in our presently expanded staff is our lack of a forest mensuration project leader. More forest management plans are being prepared currently than ever before, and we are a long way from being able to make growth predictions with confidence. Indication is that our spruce-hemlock yield table must be revised. Tree farmers from every quarter are requesting authoritative data on growth estimating technique, converting factors, and volume and yield tables to meet changing standards of utilization.

Plot remeasurements made and analyzed during the year emphasize the high growth capacity of fir region forests. Average net growth on 11 plots in 90-year-old spruce-hemlock at Cascade Head over the past decade was 1,593 board feet per acre per year. Mean annual net growth to present age is 1,454 board feet, and still increasing in spite of accumulating mortality. Permanent plots in a site III stand of Douglas-fir indicate a net growth of 18,464 board feet per acre during the 15-year period from age 45 to 60 years. This is eloquent evidence of the tremendous productivity being sacrificed when Douglas-fir is prematurely clear cut at age 40 to 50 years, as many stands are.

New Projects

Two entirely new projects, new to the Station and to the Northwest, were initiated in 1946--Forest Soils Studies and Applied Forest Management. Results of the initial study of soil factors influencing distribution of ponderosa and lodgepole pine on the central Oregon plateau indicate that the three types, pure ponderosa, mixed ponderosa-lodgepole, and pure lodgepole pine, occur on three different soil structures. Pure ponderosa stands thrive on sloping, well-drained soil underlain within root depth by basaltic rock. The mixed stands occur on a level, medium-drained soil in which a slight resistance to downward water movement is present but does not substantially restrict drainage. The pure lodgepole pine stand persists on areas of slight depression wherever water tends to concentrate and on the colder upper levels. Poor drainage is evidenced by a grayish, leached appearance in the soil profile and a cemented, mottled clay and gravel layer at about 60 inches, forming a strong resistance to downward movement of water. The inference drawn is that moisture tolerances of ponderosa and lodgepole pine, as well as fire history, condition their occurrence and result in competition between the species wherever soil drainage lies somewhere between well drained and poorly drained. Indication is that ponderosa planting should be confined to the well-drained and medium-drained soils.

Principal work under the new soils study project for 1947 will be on Douglas-fir region, soil-site evaluation.

The challenging job of Applied Forest Management is to test on woods operations of commercial size, conclusions reached from small-plot silvicultural, mensurational, and fire studies and from local economic studies. Careful records of costs and returns and comparisons of results from alternative methods will provide a practical and convincing basis for the evaluation of improved management practices for all forests within the region. Plans are to initiate this development at Wind River in Douglas-fir, at Cascade Head in spruce-hemlock and Douglas-fir, and at Pringle Falls in ponderosa pine. However, most essential to the success of this program is the selection and development of new and accessible experimental forests or cooperative study tracts in Douglas-fir forests. Problems of second-growth management will receive priority in western Washington, those of old-growth in western Oregon.

Accelerated timber cutting in southwest Oregon and in the mixed pine stands of the Blue Mountains is daily increasing pressure for research guidance in both of these areas. Thus, within the year, we expect to ready preliminary plans for activation of the Port Orford Cedar Experimental Forest in southwest Oregon, and of the Blue Mountain Experimental Forest in eastern Oregon.

RANGE RESEARCH

The Range Research Division of the Pacific Northwest Station at the beginning of 1946 set up the following three objectives to be fulfilled during the year:

1. Completion of range problem analyses for eastern Oregon and Washington.

2. Development of plans for detailed range studies on the Starkey Experimental Forest and Range.

3. Continuation of the range reseeding research program begun during the fall of 1945 with some expansion where needed.

With reorganization of the range work, establishment of work in the State of Washington, allotment of new money for the Eastern Oregon Work Center, and recruitment of additional personnel for the Division, we fell short of our objectives. In more detail our accomplishments, in light of our objectives, are as follows:

Range Problem Analyses Nearing Completion

Acreages and grazing capacities of range lands in eastern Oregon and eastern Washington are summarized by types and by seasonal ranges,

and compared with the demand for range forage by livestock and big game. Range land use and management problems are being summarized for each type, and compared to determine priority of research work on the various problems. In Washington, this necessarily included much observational work during the summer of 1946 to get acquainted with the range problems. These problem analyses, when completed, will form the basis for all range research to be planned and conducted in the Pacific Northwest.

While the analyses are not completed, certain relationships that will guide future research work are very apparent. One is that in range research work on summer range, more attention must be given to the effects of grazing on timber, watershed, and recreational (including wildlife) uses of the land and to the effects of these uses on grazing values. With timber use we find that of the 14,446,000 acres of summer range in the Pacific Northwest, 13,355,000 acres is ponderosa pine forest, nearly all of which is commercial timber available for cutting. In excess of 370,000 acres are being cut over each year. Clearly, the harvest of the timber will affect values for grazing. Conversely, grazing may affect timber reproduction. With recreational use we find that nearly all summer range land is being utilized in one form or another. Big game utilization of forage is universally present. Fourteen percent of the entire demand for summer range in eastern Oregon is by deer and elk. With watershed we find that nearly all summer range is on the headwaters of important streams in the Pacific Northwest. Watershed values will be directly affected by grazing use, and the effect of grazing on watershed values is a primary consideration. These same relationships, except for timber production, are present on spring-fall ranges. Consequently, just as on summer ranges, future research on the spring-fall range must consider watershed and wildlife values.

To carry on range research, as such, with proper consideration for other values is going to call for the most careful coordination of range research work with that of the other divisions.

Starkey Range Plans Nearing Completion

Although preparation of project analyses and working plans generally are awaiting completion of the problem analyses, plans for the study of cattle management on the Starkey Experimental Forest and Range are being prepared, because this problem has been consistently recognized as the most important in the region. With an increase in cattle population during the war years early attack on this problem becomes even more necessary. It is planned to compare season-long and rotation-deferred systems, each at three different grazing intensities. An attempt is being made, in drawing up plans, to permit the collection of data on effects of grazing practices on soil and water whenever a forest influences division is set up at this Station. Construction of some of the needed facilities will get under way as soon as the plans are completed and approved.

Range Reseeding Work Continued and Expanded

Seedings according to plan were made in 1946 on all areas established in 1945 and six new species adaptability trials and one nursery were established. Three of the trials are in the sagebrush type, two are in the cheatgrass type, and ten are in the ponderosa pine zone. Four trials and one nursery are located in Washington. The remainder are in Oregon. A two-year study testing 12 methods of planting perennial grasses in cheatgrass was set up on the Doneen ranch near Wenatchee, Washington. The primary objective of this study is to determine how to establish perennial grasses in cheatgrass stands, and the extent to which these perennials will decrease fire hazard.

Plantings made in 1945 are beginning to bear fruit. For example, they are calling attention to the relative priority of problems. Tentative results from 1945 plantings indicate that, in the ponderosa pine zone, method of planting may be the most difficult problem to solve. In most situations, we will have many adaptable species from which to select. But in many cases, hitherto unrecognized competition from lush spring flora such as onions and moss is thought to be one of the principal causes of past failures, and competition from tarweed, groundsmoke, and other annuals must be overcome.

Tentative results from studies in the Wallowa Mountains indicate that tarweed competition may be materially lessened and good stands of grass obtained by broadcasting the seed and harrowing with a pipe harrow in the early spring when the tarweed is about an inch tall. Of the eight species used in these trials, seven good or very good stands, and only one poor stand were obtained when so seeded. In contrast, when these same species were seeded on unprepared seedbeds by drilling in the fall or broadcasting and harrowing in the fall, the systems commonly used in the past, they gave only poor stands or failures.

Seedings made in 1939 on the Big Cow Creek burn were reexamined in 1946. Except for timothy and mountain brome, all species were producing as much or more forage in 1946 as in 1942. Timothy, which made the most spectacular initial growth, was producing only 212 pounds of air-dry herbage per acre in 1946 compared with 804 pounds per acre in 1942. Mountain brome had disappeared from the stand. Orchardgrass, now the most outstanding grass on this area, was producing an average of 591 pounds of air-dry herbage per acre in 1946 compared with 520 pounds in 1942. Lodgepole pine seedlings in all grass plantings showed some increase over 1942 but not enough to be of practical importance. The greatest number of seedlings was 305 per acre.

Progress Being Made in Development of Reseeding Equipment

Substantial progress has been made in the reseeding equipment development program. This program, guided by an interregional

committee of which Pechanec is chairman, is carried on in cooperation with the Equipment Laboratory. To date, efforts have been concentrated on improvements in the designs of the pipe harrow, and the A- and Supp rails. Changes in designs were incorporated on models constructed in Portland and tested on the Fremont National Forest. The revised design of the pipe harrow was found to be sufficiently satisfactory that copies of the design and specifications were sent to all western regions and stations. Further changes in the design of the A- and Supp rails are now being made and additional trials will be made this winter. A detailed program for the design and construction of a new brushland disc plow (similar in many respects to the wheatland) was drawn up at a meeting of the committee. Design and construction of this implement is to be one of the major reseeding equipment development projects carried on in 1947.

Headquarters Shifted to East of the Cascades

Early in 1946 the headquarters for men in range research, with exception of the Division Chief, were shifted to eastern Washington and eastern Oregon. E. H. Reid was placed in charge of the work in eastern Oregon with headquarters at La Grande. R. S. Rummell was placed in charge of the work in central Washington with headquarters at Wenatchee. This move was made to place the men closer to the problems with which they were working. With the establishment of a headquarters at Wenatchee, considerably more emphasis can be given to range research work in central Washington.

With the appropriation of funds for the Eastern Oregon Work Center, the range staff was enlarged. Three additional positions were set up and Ellerslie Stevenson, George Garrison, and R. W. Harris were secured to fill the positions. Harris is being transferred from the Rocky Mountain Station and the other two men are new to the range research organization. These men bring to the Range Research Division a background of soils and ecology.

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PERSONNEL

ADMINISTRATION

J. Alfred Hall	Director
Samuel E. Kistler	Administrative Assistant
June H. Wertz	Administrative Assistant
Frances Elliott	Clerk-Stenographer
Ruth H. Campbell	Clerk
Erna J. Jeppesen	Library Assistant
Annette M. Kleve	Messenger
Cavel V. Sherman	Messenger

FOREST ECONOMICS

Robert W. Cowlin	Forest Economist
Elsa E. Wasser	Clerk-Stenographer

Cooperative Project with Bonneville Power Administration

Ralph W. Marquis	Forest Economist
Leah Wheeler	Clerk-Stenographer

Temporary

Gerald M. Meier	Clerk

Forest Survey Inventory

Floyd L. Moravets	Forest Economist
Richard C. Wilson	Forest Economist
George E. Morrill	Forest Economist
Floyd A. Johnson	Forester
Richard C. Grant	Forester
Walter R. Johnson	Forester
Carl E. Mayer	Forester
Paul R. Thompson	Forester
Samuel A. Newman	Forester
George S. Meagher	Forest Economist
Bruce A. Elmgren	Agricultural Aid

Temporary

A. Kathryn Flaherty	Draftsman
Willard H. Carmean	Agricultural Aid

Forest Fire Economics

Donald N. Matthews	Forest Economist
Lloyd H. Fullington	Forester

Requirements, Production, and Supplies (WPB)

Sinclair A. Wilson	Forest Economist
George E. Morrill	Forest Economist
Inga E. Fulkerson	Statistical Clerk
Elsa E. Wasser	Clerk-Stenographer

Lumber Census and Other Statistics

Herman M. Johnson	Forester
George E. Morrill	Forest Economist
Christina M. McPhail	Clerk

FOREST MANAGEMENT RESEARCH

Philip A. Briegleb	Silviculturist
Thornton T. Munger	Silviculturist
Leona M. Bates	Clerk-Stenographer
Emma G. Johnson	Clerk-Stenographer

Silviculture

Leo A. Isaac	Silviculturist

Fire Protection

William G. Morris	Silviculturist
Harold A. Rapraeger	Silviculturist

Forest Management Research Work Centers:

Western Washington Work Center (Olympia, Wash.)

Norman P. Worthington	Forester
Robert F. Tarrant	Soil Scientist
George R. Staebler	Forester

Western Oregon Work Center (Corvallis, Oreg.)

Robert Aufderheide	Forester
Roy R. Silen	Forester
Harold A. Rapraeger	Silviculturist

Forest Management Research Experimental Forests

Pringle Falls Experimental Forest

Edwin L. Mowat	Forester

Temporary

Walter G. Dahms	Forester
Reed J. Howard	Agricultural Aid

Wind River Experimental Forest

Robert W. Steele	Forester

Cascade Head Experimental Forest

Melvin P. Twerdal	Forester
Robert H. Ruth	Forester

RANGE INVESTIGATIONS

Joseph F. Pechanec	Forest Ecologist
Robert S. Rummell	Range Examiner
May W. Van Staaveren	Clerk-Stenographer

Range Investigations - Work Centers

Eastern Oregon Work Center (La Grande, Oreg.)

Elbert H. Reid	Forest Ecologist
Ellerslie W. Stevenson	Forest Ecologist
Harold J. Jensen	Agricultural Aid

Temporary

William A. Sawyer	Conservationist

FOREST UTILIZATION SERVICE

James J. Byrne	Technologist
Edward G. Locke	Chemical Engineer
Elmer E. Matson	Forester
Archibald C. Knauss	Technologist
Vivian B. Heigh	Clerk-Stenographer